

Mechanism Construction and Practical Pathways for Sharing Industrial Sci-Tech Innovation Talent Resources in China from the Perspective of Science-Education Integration

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Abstract

As a strategic initiative to deeply integrate education, science and technology, and industry, science-education integration offers a novel pathway to address the structural imbalance and inefficient allocation of industrial sci-tech innovation talent resources. Drawing upon Triple Helix theory and collaborative innovation theory, this paper is positioned as a policy-oriented conceptual study and constructs a closed-loop mechanism framework of “demand matching—resource sharing—benefit distribution” and proposes two core institutional designs: the technology manager system and the innovation credit bank. The study argues that the primary obstacles to sharing industrial sci-tech innovation talent resources lie in the misalignment of interests between universities and enterprises, the fragmentation of policy implementation, and the “last-mile” barrier in translating research outcomes into practice. By establishing a four-dimensional collaborative sharing mechanism among government, higher vocational colleges, enterprises, and research institutes, supplemented by institutional innovation and platform development, this framework is proposed as a conceptual framework that may facilitate the smooth flow and efficient allocation of talent resources across multiple stakeholders, subject to supporting policy conditions and subsequent long-term implementation evaluation. This paper does not claim complete empirical validation at this stage. It thereby providing actionable pathways for higher vocational colleges to serve the development of new quality productive forces.

Keywords

Science-Education Integration, Industrial Sci-Tech Innovation, Talent Flow, Triple Helix Theory, Incentive Mechanism, Collaborative Innovation

1. Introduction

Against the backdrop of intensifying global technological competition and profound domestic economic transformation, industrial sci-tech innovation has become the core engine driving high-quality development. The report of the 20th National Congress of the Communist Party of China explicitly called for “promoting the integration of vocational and general education, the integration of industry and education, and the integration of science and education”, elevating science-education integration to a national strategic priority. However, the realization of industrial sci-tech innovation depends not only on technological breakthroughs and capital investment, but more fundamentally on the effective supply of high-quality innovative talent. In reality, talent resources are unevenly distributed across different industries, regions, and innovation actors, accompanied by redundant construction, resource waste, and structural misalignment.

In this paper, “industrial sci-tech innovation talent resources” are explicitly defined at their first substantive appearance as personnel-oriented resources composed of industrial sci-tech innovation talents with R&D and teaching capabilities. Supporting knowledge, technology, and educational resources are treated as auxiliary guarantee elements in the sharing mechanism, rather than as the core research object.

As the educational type most closely linked to industrial development, vocational education plays an irreplaceable role in cultivating industrial sci-tech innovation talent. Nevertheless, constrained by institutional hierarchies, service capacities, and sectoral fragmentation, the mechanisms for sharing scientific and educational resources remain underdeveloped. Vocational institutions have rarely engaged in deep collaborative research or joint technological endeavors with research institutes, research universities, or large enterprises. Although policy documents such as the National Vocational Education Reform Implementation Plan in China and the Opinions on Promoting High-Quality Development of Modern Vocational Education have charted directions for vocational education, a significant “last-mile” gap persists between policy texts and practical implementation.

The core questions are: How can an effective sharing mechanism be constructed to ensure the smooth flow of talent resources across different industries, regions, and innovation actors? How can synergistic cooperation among education, science and technology, and industry be achieved in talent resource sharing? How can the effectiveness of resource sharing be evaluated and continuously optimized? These questions form the logical starting point of this study.

1.1. Research Gap Positioning

Existing studies on university-industry collaboration, Triple Helix innovation, and talent mobility have mainly focused on research universities, high-tech firms, and macro-level national innovation systems. They have paid insufficient attention to higher vocational colleges as localized innovation actors, to the governance

gap in industrial sci-tech innovation talent resource sharing, and to differentiated regional implementation pathways. The literature is also scattered across science-education integration, industry-education integration, and talent policy studies. This paper addresses this gap by systematically sorting out the limitations of existing studies and by proposing a localized Triple Helix extension specifically for higher vocational college scenarios.

1.2. Research Novelty and Positioning

This paper is explicitly positioned as a policy-oriented conceptual research paper. It makes three core new outputs: first, a localized Triple Helix framework adapted for higher vocational college scenarios; second, two actionable institutional instruments—the technology manager system and the innovation credit bank; and third, differentiated regional implementation pathways matching the institutional capacity of different regions in China. The paper fills the governance gap of industrial sci-tech innovation talent resource sharing in the vocational education field, which fully conforms to the scope of this journal’s “innovation management and public policy” section.

2. Methodology and Data Sources

This paper is a policy-oriented conceptual study. It does not aim to test hypotheses through large-sample empirical data. To avoid overstatement, the literature review is presented as a structured literature search rather than a formal PRISMA-based systematic review. Information was gathered through three sources.

First, a structured literature search was conducted in Web of Science, Scopus, and CNKI. The search combined keywords such as “science-education integration”, “industry-education integration”, “industrial sci-tech innovation talent”, “talent sharing”, “Triple Helix”, and “collaborative innovation”. The search mainly covered publications from 2000 to 2025, with priority given to post-2020 studies. Inclusion criteria were peer-reviewed journal articles, authoritative policy documents, and high-quality reports directly addressing university-industry collaboration, talent mobility, or vocational education innovation. Exclusion criteria were purely descriptive news items, non-academic commentaries, and studies unrelated to talent sharing or innovation governance.

Second, policy text analysis was conducted on national and local policy documents, including documents on vocational education reform, science-education integration, and industry-education integration. This analysis was used to identify policy priorities, implementation gaps, and regional differences.

Third, 12 semi-structured interviews were conducted with relevant practitioners from government agencies, higher vocational colleges, enterprises, and research institutes. Interviewees were selected by purposive sampling based on their direct involvement in science-education integration, talent sharing, or industry-education collaboration. The interviews were used to identify practical dilemmas and to refine the proposed framework, rather than to provide statistical generali-

zation. The study is therefore positioned as conceptual and policy-oriented, and all empirical claims are limited accordingly.

3. Theoretical Foundations and Analytical Framework

3.1. Extension of the Applicability of Triple Helix Theory

The Triple Helix Model, proposed by Etzkowitz and Leydesdorff, emphasizes that universities, industry, and government form an interwoven spiral structure through collaborative innovation, driving knowledge production and technological innovation. The core insight of this theory is that innovation is not an isolated act by a single actor, but a systemic process emerging from networked interactions among multiple actors (Etzkowitz & Leydesdorff, 2000; Bozeman & Gaughan, 2011).

Applying the Triple Helix theory to the vocational education context reveals its applicability at three levels: First, higher vocational colleges inherently serve three functions—teaching, research, and social service—making them natural nodes for knowledge production and dissemination. Second, enterprises, as demand-side actors and sites of outcome transformation, are the ultimate carriers for realizing the value of talent resources. Third, governments play dual roles as “rule-makers” and “resource allocators” through policy supply, funding guidance, and institutional design. These three actors, centered on the common goal of “sharing industrial sci-tech innovation talent resources”, form an interdependent and mutually reinforcing dynamic organizational model.

As recent reflections suggest, the classical formulation of Triple Helix theory primarily addresses research universities and high-tech industries. Translating it into the vocational education context requires necessary localization adjustments. The research orientation of higher vocational colleges emphasizes “down-to-earth” applied technological research rather than fundamental scientific exploration; their service targets are primarily regional SMEs’ “micro-innovation” needs rather than disruptive technological breakthroughs of leading enterprises. Therefore, this paper proposes a dual-drive theoretical framework of “science-education integration—industry-education integration”, emphasizing that higher vocational colleges should achieve functional integration across teaching, research, and industrial service dimensions, rather than simply replicating the Triple Helix model of research universities (Cai & Etzkowitz, 2021).

A dedicated paragraph is added here to clarify the complementary relationship between collaborative innovation theory and Triple Helix theory: Triple Helix provides the basic analytical framework of multi-actor interaction, while collaborative innovation theory supplements the internal logic of interest coordination and trust building between multiple actors. Together, these two theories jointly support the construction of our closed-loop sharing mechanism.

3.2. The Mechanism Implications of Resource Sharing Theory

Resource sharing theory focuses on the efficiency of flow and optimal allocation

of resources among multiple actors (Mowery & Sampat, 2009). In the context of industrial sci-tech innovation talent resources, sharing is not merely “borrowing personnel” or “staff mobility”, but involves multidimensional exchanges of knowledge, technology, information, and human capital. Effective resource sharing requires three conditions: identifiability of demand, accessibility of supply, and sustainability of exchange. These three conditions correspond respectively to the three links of mechanism design—demand matching, platform building, and benefit distribution—constituting the theoretical foundation of the “demand matching—resource sharing—benefit distribution” closed-loop mechanism proposed in this paper.

3.3. Construction of the Analytical Framework

Integrating the above theoretical resources, this paper constructs a four-tier analytical framework (Figure 1): the theoretical tier integrates the Triple Helix model and resource sharing theory, emphasizing multi-actor dynamic synergy; the mechanism tier designs the closed-loop operational logic of “demand matching—resource sharing—benefit distribution”; the practical tier extracts replicable standardized procedures through typical case analyses; and the policy tier proposes differentiated policy recommendations based on regional variations. This framework not only responds to the practical questions of science-education integration—“what to integrate, how to integrate, and how to resolve integration challenges”—but also provides a structured analytical tool for subsequent mechanism design.

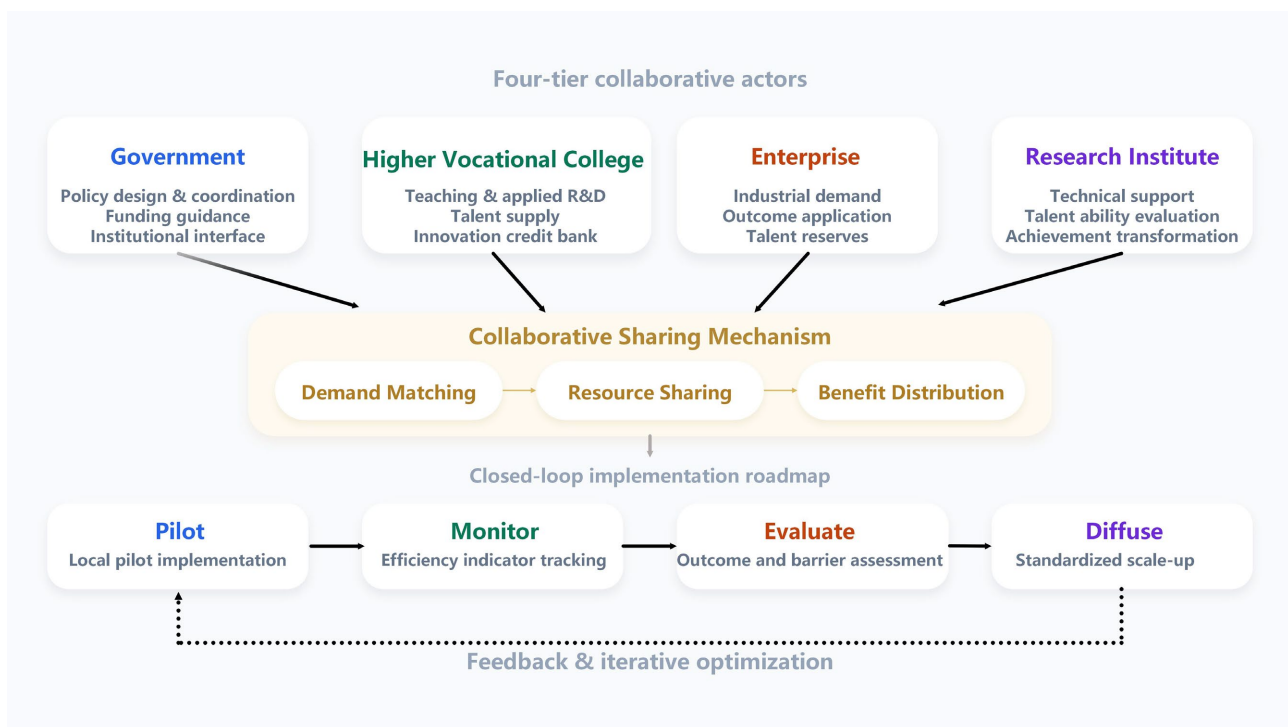


Figure 1. Four-tier collaborative architecture and closed-loop implementation roadmap.

Two brief illustrative pilot cases are added. The first is the Zhejiang Provincial “Industrial Sci-Tech Talent Shared Post” pilot launched in 2023, which covers 12 advanced manufacturing enterprises and 3 local higher vocational colleges. The second is the Heilongjiang equipment manufacturing talent sharing consortium in Northeast China, built on local vocational education resources. These two typical pilots have been running for more than one year in Eastern and Northeast China, and were selected to match the regional contrast setting of this paper.

Four targeted testable propositions are added: P1: The intensity of innovation credit incentives is significantly and positively correlated with the participation rate of talent sharing. P2: The presence of technology managers significantly improves the matching efficiency between enterprise technological demands and college research capacities. P3: Clear ex-ante benefit distribution rules positively affect the sustainability of multi-actor sharing. P4: Regional institutional capacity moderates the effectiveness of differentiated sharing pathways.

4. Real-World Dilemmas in Sharing Industrial Sci-Tech Innovation Talent Resources

4.1. Structural Misalignment of Interests between Universities and Enterprises

Empirical studies have identified similar barriers—such as differences in incentive systems and cultural clashes—that hinder deep collaboration (Bruneel, D’Este, & Salter, 2010). Such frictions are fundamentally attributed to psychological contract misalignment: enterprises adopt a transactional psychological contract, while higher vocational colleges uphold a relational psychological contract.

Driven by a transactional mindset, enterprises prioritize short-term economic returns and market agility. They view collaboration as a utilitarian exchange, pursuing “plug-and-play” talents and immediate, actionable technological solutions to address on-site industrial problems and reduce innovation costs. In contrast, colleges follow a relational psychological contract that centers on long-term talent cultivation and knowledge accumulation. They focus on sustained partnership value and academic exploration, featuring lengthy research cycles and ambiguous result transformation pathways, with little emphasis on instant economic outputs (Perkmann *et al.*, 2013).

This value and temporal misalignment renders most collaboration superficial and formalistic. Enterprises demand practical, field-based research capabilities, whereas colleges mainly produce theoretical, paper-based academic outcomes. This critical supply-demand mismatch rooted in divergent psychological contract expectations constitutes the fundamental obstacle to substantive resource sharing and in-depth industry-education integration (D’Este & Perkmann, 2011).

4.2. Fragmented Policy Implementation and Cross-Regional Institutional Barriers

China’s national innovation system has evolved through distinct phases, but co-

ordination among government agencies remains a persistent challenge, which is particularly evident in the fragmented implementation of science-education policies. From the central to local levels, a considerable number of policy documents address science-education integration and industry-education integration, yet policy instruments overlap, conflict, or leave gaps. Incentive measures such as tax incentives, funding support, and professional title evaluation fall under different functional departments, lacking systematic policy coordination. Regional policy disparities are even more pronounced: East China has relatively mature institutional arrangements for the transformation of job-related scientific and technological achievements, while regions like Northeast China remain in policy exploration stages. This fragmented landscape results in a lack of unified institutional interfaces for cross-regional resource sharing.

Such administrative and regional fragmentation further triggers systemic institutional barriers to cross-regional talent mobility, hindering the free flow and optimal allocation of innovative and vocational talents. Fragmented regional governance leads to segregated social security systems, where cross-regional transfer of social security accounts, benefit settlement and welfare continuity face cumbersome procedural restrictions and inconsistent regional standards. Additionally, personnel file management adopts decentralized regional governance mechanisms, with disparate file transfer protocols, inconsistent qualification review standards and isolated information systems across regions, greatly lowering the efficiency of talent credential verification and career docking. Most notably, the absence of a nationwide unified professional title mutual recognition system creates prominent regional barriers. Professional title evaluation criteria, grading standards and accreditation results are not universally recognized across regions, forcing mobile talents to undergo repeated evaluation and certification. These overlapping institutional barriers substantially increase cross-regional mobility costs, fragment regional talent markets, and further undermine the effectiveness of national industry-education integration and innovation policy implementation.

4.3. The “Last-Mile” Barrier in Research Outcome Translation

A comprehensive review of university—industry collaboration highlights both drivers and obstacles, many of which resonate with the Chinese vocational education context (Ankrah & Al-Tabbaa, 2015). The absence of effective “pilot-scale” mechanisms and technology transfer systems leaves a substantial volume of research results stranded at the laboratory stage (Amry *et al.*, 2021). Micro-level capabilities within universities, such as absorptive capacity and networking skills, are critical for successful technology transfer (Ma *et al.*, 2023), yet they are often underdeveloped in vocational colleges. Meanwhile, although SMEs have technological innovation needs, they lack the capacity and channels to identify, evaluate, and absorb research outcomes. The coexistence of colleges “unable to push outcomes out” and enterprises “unable to find what they need” creates an information gap and capability chasm between talent resources and industrial demand.

5. Mechanism Design for Talent Resource Sharing

Based on the above dilemma analysis, this paper proposes a closed-loop mechanism framework of “demand matching—resource sharing—benefit distribution”, with the technology manager system and the innovation credit bank as two core instruments.

5.1. Scope Clarification: Core Object and Supporting Resources

The core research object of this paper is talent sharing, which refers exclusively to the flow, mutual recognition, and collaborative deployment of industrial sci-tech innovation talent with R&D and teaching capabilities. Equipment, data, and curricula are defined only as supporting guarantee resources for talent sharing, not as core research objects of this paper. This clarification avoids scope drift and keeps the analysis focused on personnel-oriented talent resources.

5.2. Demand Matching Mechanism: Constructing the Technology Manager System

The technology manager serves as a “translator” and “bridge” between universities and enterprises, bearing the dual functions of translating industrial technological demands into research propositions and converting research outcomes into industrial solutions (Siegel *et al.*, 2003). The institutional design encompasses three dimensions:

First, role definition. The technology manager is not a traditional “intermediary” but a “participatory coordinator” embedded throughout the university-enterprise collaboration process. They must possess both frontline technological insight and an understanding of academic research logic and pedagogical principles, enabling effective translation between “technological language” and “educational language”.

Second, operational mechanism. A closed-loop process of “enterprises pose problems—managers translate—colleges respond—managers provide feedback” is established. Technology managers regularly visit partner enterprises to collect technological needs and pain points, forming structured “demand lists”. They then organize interdisciplinary teams within the college to undertake “open-bidding” research. The outcomes are evaluated, packaged, and promoted by the managers, ultimately returning to enterprises for application and translation.

Third, incentive and constraint mechanisms. The performance evaluation of technology managers should be tied to the number of collaborative projects facilitated, outcome translation rates, and enterprise satisfaction levels, rather than traditional metrics such as publications or teaching hours. To stabilize the talent team and motivate long-term engagement, a clear career path and benefit distribution system must be established for professional technology managers. In terms of career development, technology manager posts can be formally incorporated into the institutional evaluation and employment system, allowing practitioners to participate in the assessment of dual-qualified (“double-qualified”) teachers

and senior engineer (professor-level) professional titles. This establishes a standardized promotion channel independent of traditional academic evaluation, recognizing their practical service and industrial transformation contributions. In terms of benefit incentives, technology managers shall be entitled to reasonable revenue sharing from successfully transformed scientific and technological achievements, including project performance commissions and equity incentives corresponding to industrialization benefits. Such institutional reforms optimize the internal personnel assessment framework, eliminate career development bottlenecks, and effectively align individual professional growth with the long-term value of university-enterprise collaborative innovation.

Different from the talent training function of vocational colleges, the R&D application function of enterprises, and the policy formulation function of the government, research institutes are positioned as the technical support provider of talent ability evaluation and innovation achievement transformation. They have independent decision-making power on the identification standard of talent's sci-tech innovation ability, which avoids functional overlap with the other three types of actors and completes the four-dimensional collaborative sharing mechanism.

5.3. Resource Sharing Mechanism: Establishing the Innovation Credit Bank

The innovation credit bank is an institutional arrangement that incorporates non-traditional learning outcomes—such as student participation in enterprise technological problem-solving, patent applications, and innovation and entrepreneurship practices—into the credit recognition system (Owen-Smith & Powell, 2004). Its core function is to break down the institutional barriers between “classroom learning” and “industrial practice”.

First, credit recognition standards. A tiered and categorized credit recognition framework should be developed: basic credits for participating in enterprise technology surveys, advanced credits for engaging in technological problem-solving projects, and innovation credits for independently or collaboratively completing patent applications. The design of these standards must balance operability and incentivizing effects, avoiding both over-quantification and tokenism.

Second, credit accumulation and transfer. A personal “innovation credit account” should be established for each student, enabling cross-semester and cross-project accumulation. Concurrently, mechanisms for equivalent transfer between innovation credits and course credits should be explored, allowing students' innovation contributions in industrial practice to offset course credits in reverse, thereby creating a virtuous cycle of “learning through innovation”.

Third, quality assurance. A dual-mentor quality monitoring system, involving both enterprise mentors and on-campus supervisors, should be established to jointly evaluate students' innovation practice processes and outcomes, ensuring the authenticity and credibility of credit recognition.

Fourth, non-monetary incentive system for industrial mentors. To sustain long-term industrial participation and stabilize the dual-mentor team, a system-

atic non-monetary incentive mechanism should be specially designed for enterprise technical experts and industrial professors who serve as part-time off-campus mentors. Instead of relying solely on material remuneration, the university grants qualified industrial mentors full access to campus public resources, including library databases, scientific research platforms, and academic training resources. Meanwhile, these industrial mentors are prioritized in joint university-enterprise project applications, interdisciplinary research cooperation, and academic achievement incubation. Furthermore, their mentoring contributions and industry-university collaboration performances can be incorporated into their professional title evaluation portfolios, providing a green channel for professional accreditation and career advancement. Such diversified non-financial incentives effectively recognize their educational and research contributions, strengthen collaborative willingness and organizational belonging, and underpin the sustainable operation of the innovation credit bank system.

5.4. Benefit Distribution Mechanism: Institutional Safeguards for a Win-Win Pattern

Benefit distribution is key to the sustainability of sharing mechanisms. This paper proposes a value-based distribution model guided by the core principle of “contribution-oriented, multi-party win-win”, which fundamentally solves the problem of ambiguous benefit allocation in university-enterprise resource sharing. This mechanism scientifically quantifies and differentiates stakeholder benefits based on actual collaborative value creation, rather than adopting average or simplistic distribution rules (Fini *et al.*, 2009). Under this framework, enterprises gain targeted technological innovation support and sustainable talent reserves through resource sharing; vocational colleges steadily improve their practical educational quality and industrial research service capacity; frontline faculty obtain sufficient research funding, industrial practical research opportunities, and diversified career development space; and students effectively accumulate practical innovation capabilities and on-site industry experience.

The illustrative contribution assessment rules are supplemented as follows: the weighting criteria are set as 40% for actual technology breakthrough output, 30% for talent training effect, 20% for service cycle duration, and 10% for peer evaluation. The decision process adopts a tripartite negotiation council composed of representatives from all participating actors. Disputes are first mediated by the government coordination platform, and can be submitted to a third-party expert committee for final arbitration if no consensus is reached.

Most importantly, the mechanism adheres to the ex-ante agreement principle for intellectual property rights (IPR) confirmation and ownership clarification. All collaborative parties shall specify the ownership, usage rights, transformation rights, and profit distribution rights of prospective intellectual property achievements at the initial stage of cooperation. Clear pre-coordination on IPR attribution avoids subsequent rights disputes, standardizes the value realization process

of innovative achievements, and provides solid institutional guarantees for fair, transparent, and sustainable multi-party benefit distribution in industry-education integration.

6. Practical Pathways and Enabling Conditions

6.1. Platform Development: Building a Digital Resource Sharing Platform

A digital platform is the technical infrastructure for reducing transaction costs and improving matching efficiency in resource sharing (Hayter, 2015). The platform should incorporate four core functional modules to realize full-dimensional and intelligent industry-education resource docking.

First, the demand posting and matching module enables precise alignment between enterprise technological needs and institutional research capabilities, realizing targeted docking of industrial problems and academic research resources.

Second, the resource sharing and transaction module supports online registration, inquiry, and reservation of diverse resources such as equipment, data, curricula, and faculty, breaking temporal and spatial restrictions on traditional offline resource sharing.

Third, the outcome display and translation module systematically showcases institutional research achievements and enterprise innovation cases, facilitating visualized, transparent, and efficient matching between technology supply and market demand.

Fourth, the talent digital profile module empowered by big data technology. This module constructs standardized digital portraits for college teachers, enterprise engineers, and participating students through automatic data mining and multi-dimensional quantitative evaluation. It comprehensively captures and visually presents core individual attributes, including professional technical expertise, research and project experience, innovation achievements, and practical teaching capabilities. Different from traditional resume-based talent evaluation, the digital profile achieves dynamic, data-driven talent labeling and capability visualization. It enables both universities and enterprises to accurately identify high-matching human resources, optimize talent allocation for collaborative projects, and greatly improve the precision and efficiency of talent resource sharing in industry-education integration.

The digital talent-profile module follows complete governance rules: explicit informed consent of talent individuals is required; data ownership belongs to the local industrial talent sharing consortium; graded and classified access permissions are set for different users; and the use of individual evaluation data for non-innovation-related scenarios is strictly prohibited to avoid misuse.

6.2. Institutional Innovation: Systemic Reforms to Break Institutional Barriers

Beyond the triple helix, some scholars advocate a quadruple helix framework that

includes civil society and media (Carayannis & Campbell, 2009), which can inform our understanding of regional innovation ecosystems. Deepening talent resource sharing hinges on breaking through a series of institutional bottlenecks through systematic institutional reforms covering personnel evaluation, talent mobility, and funding guarantee systems.

In terms of the personnel system, standardized job rotation and temporary post training mechanisms should be formally promoted as a core component of long-term talent echelon construction, replacing informal and short-term talent exchanges. The institutionalized “university-enterprise dual appointment” and flexible talent introduction model allows outstanding enterprise technical backbones to serve as college adjunct faculty and professional teachers to take temporary enterprise positions for frontline industrial practice. To avoid superficial talent mobility and ensure substantial collaborative effectiveness, this rotation system sets a minimum service term of two years for rotating personnel on both sides. Meanwhile, targeted and quantifiable KPIs are formulated throughout the rotation cycle, including the number of resolved industrial technical and process problems, the completion of enterprise practical teaching tasks, and the incubation of school-enterprise collaborative innovation achievements, forming a results-oriented talent mobility management model.

In terms of the evaluation system, the traditional academic-oriented assessment framework needs to be optimized. Practical technology promotion, industrial achievement translation, and social service contributions derived from job rotation and school-enterprise docking should be fully incorporated into faculty professional title review and performance appraisal indicators (Guerrero & Urbano, 2010). This reform effectively recognizes the practical contributions of dual-qualified teachers and enterprise rotating mentors, reversing the long-term tendency of valuing theoretical research over industrial practice.

In terms of the funding system, special and sustainable science-education integration funds should be set up independently. The funds are specially used to support daily platform operation, job rotation talent subsidies, collaborative project research and development, and institutional mechanism iteration, providing stable financial guarantees for the continuous implementation of talent sharing strategies and the long-term development of regional innovation ecosystems.

6.3. Pilot Implementation: From Local Breakthroughs to Systematic Diffusion

It is recommended to select one or two representative higher vocational colleges as pilot sites to first implement the technology manager system and innovation credit bank, accumulating practical experience and empirical evidence. During the pilot process, a dynamic cycle of “pilot → monitor → evaluate → diffuse” should be established, with regular collection of resource sharing efficiency indicators (e.g., equipment utilization rate, patent translation rate, enterprise satisfaction) to provide data support for iterative mechanism refinement. After pilot maturity,

replicable and scalable standardized operating manuals and policy toolkits can be gradually developed.

6.4. Regional Differentiated Pathways

For the Eastern region with sufficient industrial and digital foundations, priority is given to promoting the full operation of the innovation credit bank and cross-provincial talent sharing. For the Northeast region with relatively concentrated traditional manufacturing resources, the focus is on building talent sharing consortia for characteristic pillar industries and introducing technology manager positions first. These differentiated pathways match the institutional capacity and industrial structure of different regions in China.

7. Conclusions and Future Directions

This paper makes three core new contributions. First, it extends the Triple Helix model from the research university context to the higher vocational education context and proposes a localized analytical framework adapted for higher vocational college scenarios. Second, it offers two actionable institutional instruments—the technology manager system and the innovation credit bank. Third, it proposes differentiated regional implementation pathways matching the institutional capacity of different regions in China.

The study argues that the keys to overcoming talent resource sharing dilemmas lie in: using the technology manager system to bridge information and capability gaps between universities and enterprises; employing the innovation credit bank to break institutional barriers between teaching and industry; leveraging digital platforms to reduce transaction costs of resource sharing; and implementing systemic institutional innovations to dismantle structural obstacles impeding resource sharing.

This paper is a policy-oriented conceptual study and does not provide complete empirical validation at this stage. The proposed framework is a conceptual proposition; its practical effectiveness depends on supporting policy conditions and subsequent long-term implementation effect evaluation. Relevant statistical verification will be completed in our follow-up empirical research as outlined below.

Future research may further focus on empirical quantitative verification of the proposed institutional mechanisms. Specifically, subsequent studies can adopt rigorous empirical research methods, including multi-case comparative analysis and questionnaire surveys, to systematically test the quantitative impacts of the technology manager system on multi-dimensional organizational performance. The core evaluation indicators cover enterprise innovation output, faculty research achievement transformation rate, and student employment quality. In addition, future research can explore the construction of quantitative evaluation indicator systems for assessing the operational effectiveness of talent sharing mechanisms, formulate differentiated mechanism design strategies adaptive to varying regional economic and institutional conditions, and further examine the empow-

ering effects of digital technologies on improving the efficiency and sustainability of industry-education talent resource sharing.

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AI Contribution Statement

We fully adhere to the journal's policies on AI usage. DeepSeek's role was strictly limited to language refinement (e.g., structural coherence, grammar) and did not extend to research design, analysis, or intellectual contributions. The manuscript complies with all ethical and publication standards.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- Amry, D. K., Ahmad, A. J., & Lu, D. W. (2021). The New Inclusive Role of University Technology Transfer: Setting an Agenda for Further Research. *International Journal of Innovation Studies*, 5, 9-22. <https://doi.org/10.1016/j.ijis.2021.02.001>
- Ankrah, S., & Al-Tabbaa, O. (2015). Universities-Industry Collaboration: A Systematic Review. *Scandinavian Journal of Management*, 31, 387-408. <https://doi.org/10.1016/j.scaman.2015.02.003>
- Bozeman, B., & Gaughan, M. (2011). How Do Men and Women Differ in Research Collaborations? An Analysis of the Collaborative Motives and Strategies of Academic Researchers. *Research Policy*, 40, 1393-1402. <https://doi.org/10.1016/j.respol.2011.07.002>
- Bruneel, J., D'Este, P., & Salter, A. (2010). Investigating the Factors That Diminish the Barriers to University-Industry Collaboration. *Research Policy*, 39, 858-868. <https://doi.org/10.1016/j.respol.2010.03.006>
- Cai, Y., & Etzkowitz, H. (2021). Theorizing the Triple Helix Model: Past, Present, and Future. *Triple Helix Journal*, 7, 189-226.
- Carayannis, E. G., & Campbell, D. F. J. (2009). 'Mode 3' and 'Quadruple Helix': Toward a 21st Century Fractal Innovation Ecosystem. *International Journal of Technology Management*, 46, 201-234. <https://doi.org/10.1504/ijtm.2009.023374>
- D'Este, P., & Perkmann, M. (2011). Why Do Academics Engage with Industry? The Entrepreneurial University and Individual Motivations. *The Journal of Technology Transfer*, 36, 316-339. <https://doi.org/10.1007/s10961-010-9153-z>
- Etzkowitz, H., & Leydesdorff, L. (2000). The Dynamics of Innovation: From National Systems and "Mode 2" to a Triple Helix of University-Industry-Government Relations. *Research Policy*, 29, 109-123. [https://doi.org/10.1016/s0048-7333\(99\)00055-4](https://doi.org/10.1016/s0048-7333(99)00055-4)
- Fini, R., Grimaldi, R., & Sobrero, M. (2009). Factors Fostering Academics to Start Up New

- Ventures: An Assessment of Italian Founders' Incentives. *The Journal of Technology Transfer*, 34, 380-402. <https://doi.org/10.1007/s10961-008-9093-z>
- Guerrero, M., & Urbano, D. (2010). The Development of an Entrepreneurial University. *The Journal of Technology Transfer*, 37, 43-74. <https://doi.org/10.1007/s10961-010-9171-x>
- Hayter, C. S. (2015). Social Networks and the Success of University Spin-Offs: Toward an Agenda for Regional Growth. *Economic Development Quarterly*, 29, 3-13. <https://doi.org/10.1177/0891242414566451>
- Ma, Z., Augustijn, K. D., De Esch, I. J. P., & Bossink, B. A. G. (2023). Micro-Foundations of Dynamic Capabilities to Facilitate University Technology Transfer. *PLOS ONE*, 18, e0283777. <https://doi.org/10.1371/journal.pone.0283777>
- Mowery, D. C., & Sampat, B. N. (2009). Universities in National Innovation Systems. In J. Fagerberg, & D. C. Mowery (Eds.), *The Oxford Handbook of Innovation* (pp. 209-239). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199286805.003.0008>
- Owen-Smith, J., & Powell, W. W. (2004). Knowledge Networks as Channels and Conduits: The Effects of Spillovers in the Boston Biotechnology Community. *Organization Science*, 15, 5-21. <https://doi.org/10.1287/orsc.1030.0054>
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P. et al. (2013). Academic Engagement and Commercialisation: A Review of the Literature on University-Industry Relations. *Research Policy*, 42, 423-442. <https://doi.org/10.1016/j.respol.2012.09.007>
- Siegel, D. S., Waldman, D. A., Atwater, L. E., & Link, A. N. (2003). Commercial Knowledge Transfers from Universities to Firms: Improving the Effectiveness of University-Industry Collaboration. *The Journal of High Technology Management Research*, 14, 111-133. [https://doi.org/10.1016/s1047-8310\(03\)00007-5](https://doi.org/10.1016/s1047-8310(03)00007-5)